Fact Sheet

AIRCRAFT ICING

PROBLEM

In-flight icing is a persistent problem for military and civilian aviation. Icing threatens jet transports on departure and approach, but is a greater hazard to commuter craft and helicopters that prolong their exposure at slower speeds in lower altitudes. Aircraft icing forecasts are unable to forecast icing reliably and with fine spatial and temporal resolution. Several helicopters are certified to fly in light-to-moderate icing, but cannot cope with short-period intense icing or long-period moderate icing. This is particularly important for surveillance, medevac, smart weapons, and remotely piloted vehicles in areas where icing is frequent.

SOLUTION

Several approaches may lessen the impact of in-flight icing on aviation. Forecasting must improve. Aircraft icing potential is primarily a function of cloud supercooled liquid water content (SLWC) and of droplet size. Forecast model improvement could be accomplished by systematically observing SLWC and improving model algorithms. CRREL has developed, through the Small Business Innovation Research (SBIR) program, a radiosonde that measures the magnitude of SLWC vertically through clouds and could make systematic measurements. Icing forecasts could also be improved by locating areas within storms that typically produce ice. This has been accomplished by monitoring and making transects of icing within storms as they move over mountaintops. Icing has been monitored in New England, Alaska, Iceland, and Switzerland. Because forecasting is unable to produce the resolution necessary, perhaps the best way to cope with icing is to either avoid it, or design aircraft to cope with it aerodynamically. CRREL has completed an assessment of prediction detection where icing potential is remotely detected ahead of aircraft and avoided by navigation. Also, a model has been developed, using measurements from Mount Washington, that can predict ice density from aircraft and weather variables. Ice density is closely related to ice shape and location, which affect wing aerodynamics.

RESULTS

The icing radiosonde is being field-hardened and a study is proposed that will make SLWC transects of several icing storms during the 1996–97 field season. Icing forecast models are being surveyed, and several will be tested during the field trial. The sonde has been used to test the accuracy of the Army's one-time forecast algorithm—the Smith-Feddes model. Various papers have been published on the sonde in meteorological journals. Icing areas within storms have been analyzed from mountaintop studies. In New England, over 50% of icing occurs behind cold fronts, with an additional 25% ahead of warm fronts. Thus, most icing occurs in well-defined areas of storms; results have been published in the *Journal of Applied Meteorology*.

Technically and meteorologically, icing detection prediction is feasible. Appropriate technologies include lidar and radar, the latter appearing most promising. CRREL is continuing work in this area. Finally, the ice density model has been incorporated in some versions of LEWICE, the primary NASA model used for evaluating icing impacts on airfoil design.

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